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Fertilization effect of Cu-EDTA chelate on soil pH and redox conditions in a flooded neutral soil

J.M. Álvarez, M.I. Rico, D. González and P. Almendros

Dpto. Química y Análisis Agrícola, ETSI Agrónomos, Universidad Politécnica de Madrid (UPM), Ciudad Universitaria, s/n. 28040 Madrid, Spain (josemanuel.alvarez@upm.es)

Copper chelates are applied to correct copper micronutrient deficiencies in soils and one of the most commonly used is the synthetic chelate Cu-EDTA (Cu-ethylenediaminetetraacetate). The effectiveness of chelates is due to their capacity to maintain Cu in the soil solution. This is related to their stability which can be modified by the physico-chemical characteristics of the soil and especially by its pH and redox potential. Under water saturation conditions, a decrease in, or loss of, molecular oxygen leads to redox reactions that influence both the pH of the soil and the chemical forms of the ions and molecules present in the soil solution. An increase in the oxidation potential (Eh) (reducers conditions) influences the mobilization of metals adsorbed onto certain soil fractions because it enhances the concentration of reduced forms and thus the availability of metals in the soil. The aim of this study was to evaluate the effect of the Cu-EDTA chelate on pH and pe (pe=Eh(mv)/59.2) in a flooded neutral soil and to relate this effect to variations in the amount of Cu in the soil solution.

The soil selected for this study was a Typic Xerorthents whose main properties were: pH_w, 7.09 (1:1 w/v); clay content, 20%; EC, 35.2 μS/cm; OM, 1.29%; total N, 0.045%; available P, 23.37 mg kg^{-1}; cation exchange capacity, 9.304 $cmol^{+}$ kg^{-1}; base saturation, 12%; colour: dry, 10YR 4/6; wet, 7.5YR 4/6. A sample of soil fertilized with 5 mg Cu/kg soil in the form of Cu-EDTA and a control without any micronutrient fertilization were incubated under the same experimental conditions. All treatments were carried out in triplicate. The incubation of soil samples was performed for 7 days in a controlled water-holding capacity (33 KPa) of 130%,. After incubation

the pH and redox potential were measured. A volume of 20 mL of the soil solution was extracted using a syringe and filtered with an Albet (0.45 μm) cellulose filter.

The results showed that applying the Cu-EDTA chelate to the soil had a major influence on Cu mobilization and produced high levels of Cu in the soil solution. The application of this chelate resulted in an increase in Cu in the soil solution of 1.76 mg L^{-1}. The pH was also slightly modified increasing by 0.12 with respect to the control soil. On the other hand, application of the Cu-EDTA chelate produced a decrease in the Eh value of 220 mV with respect to the control. This application also produced a decrease in pe of 3.76. The (pH + pe) parameter in the control soil reached a value of 11.01, while the soil treated with EDTA had a value of 7.37.

The values of pH and Eh corresponded to those of waterlogged (semipermanently saturated) soils. The results showed that in neutral soil a synthetic chelate as stable as Cu-EDTA provided a significant reduction in the redox potential and an increase in the Cu concentration of the soil solution.